

REMARKS

In the Office action dated January 16, 2007, the examiner: objected to the drawings under 37 CFR 1.83(a); objected to the specification under 37 CFR 1.77(b); rejected claims 3, 8-10, 14-23, 25, 27 and 29-31 under 35 U.S.C. §112, second paragraph, as being indefinite; and rejected claims 1-8, 11-12, 23, 27-28 and 30 under 35 U.S.C. §102(b) as being anticipated by *Haerber et al.* The examiner indicated that claims 13, 24, and 26 are objected to as depending upon a rejected base claim and that claims 9-10, 14-22, 25, 29, and 31 would be allowable if rewritten to overcome the rejections under 35 U.S.C. §112, second paragraph.

Drawings

Claims 10, 26, and 27 have been amended by deleting features not shown in the drawings. With respect to claim 10, the phrase "being forced" has been substituted for the phrase "in force- and, in particular, spring pressurized." With respect to claim 26, the word "revolving" has been deleted. With respect to claim 27, the phrase "enlarged radially" has been substituted for "expanded in the direction of the contact member." It is believed that the objectionable features have been deleted. This has been done without prejudice, at a later date, to adding one or more of these features to the drawings and then claiming them.

Specification

Applicant submitted a substitute specification with the filing of the application and again submits the substitute specification under 37 CFR 1.125(b). This substitute specification responds to the examiner's objections to the specification under 37 CFR 1.77(b). Please replace the original specification with the attached substitute specification. No new matter has been added.

35 U.S.C. §112, second paragraph

Claims 3, 8-10, 14-23, 25, 27 and 29-31 have been amended to overcome the rejection under 35 U.S.C. § 112, second paragraph. In claim 3, the phrase "and, and particular, in its wall" has been deleted in line 2. In claim 8, the word "the" in line 2 has been deleted to introduce "sliding cams" in the claim. Claim 9 has been amended to include a cam-operated component having at least one cam ring to provide antecedent basis for "the ring". Claim 10 has been amended to delete the phrase "is force- and, in particular, spring pressurized" to overcome the indefiniteness rejection. Claim 14 has been amended to delete ", in particular ball bearings,". Claim 15 has been amended to include the cam-operated component having a cam ring with a guide slot having first and second ends to provide proper antecedent basis for "the cam ring" and "the ends." The amendment to claim 15 has provided proper antecedent basis for claim 16 which is now dependent on claim 15. Claim 17 has been amended to be

dependent on claim 16 and to include a plurality of cam rings to provide antecedent basis for "each cam ring". Claim 18 has been amended to be dependent on claim 16 providing antecedent basis for "pinion." Claim 19 has been amended to depend from claim 18 providing antecedent basis for "the driven shaft" and has been amended to introduce "a plurality of" electric motors. Claim 20 has been amended to depend from claim 18 to provide antecedent basis for "the cam ring". Claim 21 has been amended to provide antecedent basis for a "cam ring". Claim 22 has been amended to depend from claim 21 and to delete ", in particular, a so-called harmonic drive," to overcome the indefiniteness and lack of antecedent basis. Claim 23 has been amended to introduce "a supporting ring" to provide proper antecedent basis. Claim 25 has been amended to provide antecedent basis for the "wall", the "insertion end", the "cam rings", and the "supporting rings". Claim 27 has been amended to substitute "enlarged radially" for "expanded in the direction of the contact element" to overcome the indefiniteness. Claim 29 has been amended to provide antecedent basis for the "driven shaft", the "pinion", and the "cam ring." Claim 30 has been amended to depend from claim 29 so as to provide proper antecedent basis. Claim 31 has been amended to provide antecedent basis for the "driven shaft." These amendments are seen to overcome the rejections under 35 U.S.C. §112, second paragraph.

Claims 9-10, 14-22, 25, 29, and 31 have been amended to overcome the rejections under 35 U.S.C. §112, second paragraph, and, together with claims 13, 24 and 26, have been rewritten in independent form, including all limitations of any intervening claims, so as to now be allowable.

35 U.S.C. §102(b)

Claims 1-8, 11-12, 23, 27-28 and 30 are rejected as being anticipated by *Haeber et al*. Claim 1 is the only independent claim. *Haeber et al* is distinguishable from claim 1 as amended. *Haeber et al* does not disclose a first plurality of contact elements separate from a second plurality of contact elements where the first plurality of contact elements is located at one level and the second plurality of contact elements is located at a second level. *Haeber et al* discloses a single plurality of latching dogs 75 engageable with shoulders 74 and 74a formed in the inner wall of outer well member 67. By having two sets of contact elements at different levels in the connection, the parts are held in place relative to one another not only along one level but also in at least two levels so that they are held together three dimensionally.

Claims 2-8, 11-12, 23, 27-28 and 30 are allowable as depending upon allowable claim 1. Further with respect to claim 3, *Haeber et al* does not teach arranging its actuator ring 80 and outer portion 55 in the interior of wellhead connector 41. Further with respect to claim 4, *Haeber et al* does not teach a cam ring rotatably run on bearings with sliding cams on an inner surface of the ring. With

respect to claim 5, *Haeber et al* does not teach multiple cam rings located at each of the levels of the contact elements. With respect to claim 6, *Haeber et al* does not teach contact elements run in bearings in a supporting ring. With respect to claim 7, *Haeber et al* does not teach a supporting ring located at multiple levels. With respect to claim 8, *Haeber et al* does not teach sliding cams formed on the inner surface of the ring as a link guide. With respect to claim 11, *Haeber et al* does not teach contact elements at different levels or contact elements shifted in different amounts. With respect to claim 12, *Haeber et al* does not teach contact elements which are shifted to different amounts radially. With respect to claim 23, *Haeber et al* does not teach a contact element having a concave curved inner surface. With respect to claim 27, *Haeber et al* does not teach a retaining indentation enlarged radially.

Applicants have made certain voluntary amendments to the claims. All of these amendments were voluntary and none of these amendments were required for purposes of patentability. The claims have been amended so as to be in accordance with the claim format in the United States. These relate to all the amendments of claim 1 with the exception of the added phrase "the first plurality of contact elements being separate from a second plurality of contact elements" in line 7-8. Claims 1, 9, 10, 13, 15, 17, 24, 25, 26, 29, and 31 have been amended to so as to be in accordance with US claim format and to clarify the claim language such as the deletion of the phrase "characterized in that." Claim 2 has been amended to clarify the language of the claim. Claims 3 and 27 have been amended to substitute "another" for "other" to be consistent with amended claim 1. Claim 3 has also been amended by substituting "the" for "this" in line 2. Claims 5 and 7 have been amended to change "to" to "at." Claim 6 has been amended to substitute "and" for "in such a way that they." Claim 9 has been amended to clarify the claim language by inserting "rotatable" and deleting "so that it is especially rotatable." Claim 13 has been amended to change the verb. Claim 15 has been further amended to comport with the amendments relating to the lack of antecedent basis for the "ends." Claim 16 has been amended to clarify the claim language relating to "the drive device meshes." Claim 21 has been amended to clarify the claim limitations "pinions" and "driven shafts." Claim 24 has been amended to clarify the claim language relating to "the insertion end." Claim 28 has been amended to substitute "claw-shaped" for "claw-." Claim 29 has been amended, in addition to providing antecedent basis for "the driven shaft", "the pinion" and "the cam ring", to clarify the remaining language of the claim. Thus, Applicant is entitled to the application under the Doctrine of Equivalents under *Festo* with respect to the amended limitations.

New claims 32-40 have been added to further claim the present invention.

CONCLUSIONS

During the course of these remarks, Applicant has at times referred to particular limitations of the claims that are not shown in the applied prior art. This shorthand approach to discussing the claims should not be construed to mean that the other claimed limitations are not part of the claimed invention. They are as required by law. Consequently, when interpreting the claims, each of the claims should be construed as a whole, and patentability determined in light of this required claim construction. Unless Applicant has specifically stated that an amendment was made to distinguish the prior art, it was the intent of the amendment to further clarify and better define the claimed invention and the amendment was not for the purpose of patentability. Further, although Applicant may have amended certain claims, Applicant has not abandoned its pursuit of obtaining the allowance of these claims as originally filed and reserves, without prejudice, the right to pursue these claims in a continuing application.

If a petition for extension of time is necessary in order for this paper to be deemed timely filed, please consider this a petition therefore. The Commissioner is authorized to charge any additional fees incurred in this application to Deposit Account No. 03-2769 of Conley Rose, P.C., Houston, Texas.

If the Examiner has any questions or comments regarding this communication, he is invited to contact the undersigned to expedite the resolution of this application.

Respectfully submitted,



DAVID A. ROSE
Reg. No. 26,223
CONLEY ROSE, P.C.
P. O. Box 3267
Houston, Texas 77253-3267
(713) 238-8000
ATTORNEY FOR APPLICANT

COOPER CAMERON CORPORATION
P. O. Box 1212
Houston, Texas 77251

CONNECTING MECHANISM

DESCRIPTIONCROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a National Phase entry of PCT Application No. PCT/EP2003/009699 filed 1 September 2003 which claims priority to German Application No. 202 13 388.5 filed 30 August 2002, both of which are incorporated herein by reference. This application is related to the following applications: PCT/EP2003/009701 filed 1 September 2003 which claims priority to German Application No. 202 13 391.5 filed 30 August 2003, PCT Application No. PCT/EP2003/009700 filed 1 September 2003 which claims priority to German Application No. 202 13 393.1 filed 30 August 2002; PCT Application No. PCT/EP2003/009698 filed 1 September 2003 which claims priority to German Application No. 202 13 365.6 filed 30 August 2002; PCT Application No. PCT/EP2003/009697 filed 1 September 2003 which claims priority to German Application No. 202 13 389.3 filed 30 August 2002, PCT Application No. PCT Application No. PCT/EP2003/009696 filed 1 September 2003 which claims priority to German Application No. 202 13 364.8 filed 30 August 2002; and U. S. Application Serial No. 10/836,559 filed 30 April 2004, all of which are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED
RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND OF THE INVENTION

[0003] The invention relates to a connecting mechanism for two parts, which are at least partially insertable into one another, with a cam-operated component, which runs on bearings on the one part and is adjustable between a passive and active position, for shifting a number of contact elements between a withdrawal and a contact position, whereby the contact elements, when in the contact position, mesh in a retaining indentation on the other part, and with a driving device for the adjustment of the cam-operated component between the active and passive positions.

[0004] Such a connecting mechanism is known from US 2001/0011592 A1. The connecting mechanism serves, for example, but not exclusively, for the arrangement of an insertion part in a throttle element for the conveyance of gas or oil. By means of the connecting mechanism, the insertion part can be replaced quickly in case of wear or the like. In this case, the insertion part is arranged so that it is entirely in the other part, meaning in the housing of the throttle mechanism. For positioning the insertion part and holding it in place in the other part, a number of contact elements

are shifted from a withdrawal position into a contact position. The shifting is done by means of a cam-operated component that adjustably runs on bearings between a passive and an active position. In the passive position, the contact elements are arranged in their return position and in the active position the contact elements are arranged in their contact position. For retaining the contact elements in their contact position, the insertion part has a retaining indentation, which, for example, can be formed as a positioning shoulder that runs at a slant. In order to adjust the cam-operated component between the passive and active positions, the connecting mechanism furthermore presents a driving device.

[0005] It is true that the previously mentioned connecting mechanism with insertion parts inserted entirely in a housing is easily used, and that the two parts that are insertable into one another are sufficiently fixed in position with respect to one another. In addition to a further guide for the inserted part in the other part, however, additional fastening devices are necessary in order to improve the way the two parts are fixed in position relative to one another in connection with the contact elements in the contact position. This requires a relatively large design effort and is essentially only implementable for parts that are entirely inserted into one another. For example, in order to insert two parts only partially into one another, further design measures must be taken with regard to the connecting mechanism according to US 2001/0011592 A1, which measures require considerable design effort and which would raise the price of the connecting mechanism.

SUMMARY OF THE INVENTION

[0006] For this reason, the invention takes as a basis the object of improving a connecting mechanism of the type mentioned at the beginning, to the effect that, with simple design means without additional fastening or tightening devices, a secure and stable connection of parts is ensured even when these parts are only partially inserted into one another.

[0007] This object is solved by means of the features of claim 1.

[0008] According to the invention, appropriate contact elements are arranged in two or more levels, essentially parallel to the inserting direction of the two parts. In this way, the parts are held in place relative to one another not only along one level, meaning essentially linearly, but also in at least two levels, meaning essentially three-dimensionally. Furthermore, due to the arrangement of the contact elements in the different levels, an interlocking or pre-stressing of the parts when inserting them is achieved by means of only the contact elements themselves. At the same time, the adjustment of the contact elements is achieved by the allocation of the corresponding cam-operated component to each level in which the contact elements are arranged.

[0009] The connecting mechanism according to the invention is particularly advantageous in those places where the corresponding parts are only partially inserted into one another and where appropriate securing and holding of the parts relative to one another should take place in the relatively small area in which the parts are inserted into one another. Possible applications for the connecting mechanism are, in addition to the complete insertion of one part into another (see US 2001/0011592 AI), the connection, for example, of elements on an upper end of a stack of devices for the conveyance of gas or oil on the ocean floor or also on a platform with a riser or other devices leading away from this stack.

[0010] The connecting mechanism according to the invention can be especially advantageously used when the parts that can be inserted into one another are tubular. Preferably, the tubular parts are equipped with a circular cross-section at the same time.

[0011] In order to be able to arrange the connecting mechanism on one or the other part without separate built-on parts, if possible, the connecting mechanism can be arranged in the interior of the one part, particularly in its wall, whereby at least one end of the other part can be inserted into a longitudinal bore hole in the first part. With tubular parts, the connecting mechanism is arranged around the ~~centered~~-centered longitudinal bore hole in this connection.

[0012] In order to implement an adjustment of the cam-operated component in a simple way, the cam-operated component can present at least one rotating cam ring, running on bearings, with sliding cams on an inner surface of the ring. It is also possible for the sliding cams to be arranged on an outer ring surface of the cam ring, so that the contact elements can be shifted radially towards the outside. This is especially advantageous when the part formed with the cam-operated component is slid into the other part.

[0013] In order to shift the contact elements arranged in the different levels between the withdrawal and contact positions, one cam-operated component or cam ring can be satisfactory. With the appropriate rotation of the cam ring, the contact elements are then correspondingly shifted in all levels. There is, however, also the possibility of allocating one cam ring to each level of contact elements. In this case, if there were wearing, for example, it would be necessary to replace only one cam ring allocated to one level, by means of which the maintenance is simplified and made more economical.

[0014] To support the contact elements in such a way that they can be easily shifted between the withdrawal and the contact positions, the contact elements can be correspondingly kept on bearings in a supporting ring so that they are adjustable.

[0015] At the same time, the supporting ring can extend in the length direction of the part so far that it holds the contact components that are arranged in the different levels.

[0016] In any case, it is also possible, in connection with the supporting ring, that one supporting ring is allocated to each level. In different embodiments of the connecting mechanism according to the invention, it is possible, for example, for only one cam ring to adjust contact elements in different supporting rings, for more than one cam ring to adjust contact elements in more than one supporting ring and, furthermore, it is also possible for more than one cam ring to move contact elements arranged in one supporting ring in more than one level.

[0017] In order to form the appropriate sliding cams on the cam-operated component in a simple way, the sliding cams can be formed on the inner surface of the ring as a link guide.

[0018] It is possible for the different contact elements to be restrictedly guided by the sliding cams or the link guide, which means that an essentially physical connection exists between them. With another embodiment, which distinguishes itself particularly because of its simple design and improved maintenance possibilities, the contact element, with a particularly rotatable locating element that runs on bearings, can make contact on the inner surface of the ring of the cam-operated component or of the cam ring. In this way, when the cam ring is twisted, the locating element moves along the corresponding sliding cams or the link guide, and accordingly, because of this contact, the displacement of the contact element between the withdrawal and the contact positions take place.

[0019] In order to ensure in a simple way that the locating element lies against the sliding cams or the link guide or that the contact element lies against the sliding cams by means of the link guide, the contact element can be force- and, in particular, spring-~~pressurised~~pressurized in the direction of the withdrawal position. In this way, the contact element is always pressed in the direction of the cam-operated component, so that it is ensured that it is arranged in the withdrawal position with the appropriate rotation position of the cam-operated component.

[0020] Due to the arrangement of the contact elements in different levels, there furthermore is the possibility, for example, to react in a very simple way to the different dimensions of the other part or to allow different meshing capabilities of the contact elements in the corresponding retaining grooves in the longitudinal direction of the components or also in the circumferential direction of the components. In particular, this can occur when the contact elements present different levels and/or contact positions that are shifted radially inward, by different widths, in at least one level.

[0021] In order to further ~~stabilise~~stabilize the connection between the parts, the contact elements of different levels can be arranged offset to one another in the circumferential direction.

[0022] In order to keep the cam rings and, where appropriate, also the supporting rings at a distance and to ensure concentric running of the cam rings, in particular, in a simple way, pivot bearings, in particular, ball bearings, can be arranged between adjacent cam rings.

[0023] In order to determine, in a simple way, the passive and active positions of the cam-operated component or the different cam rings, the cam-operated component or the cam ring can present a guide slot running in the direction of rotation, where its ends essentially determine the passive and active positions.

[0024] There are different possibilities for allowing the twisting of the cam ring or of the cam-operated component by means of the appropriate driving device. One simple possibility can be seen if the cam ring presents gearing along at least one part of an outside circumference, with which gearing a pinion, rotatable by the driving device, meshes. In this connection, it is possible that even when there are a number of cam rings, all can be twisted at the same time by an appropriately formed pinion. If the cam rings are to be twisted between the passive and active positions in different directions, however, or, for example, if it should be possible to select whether a different number of cam rings should be twisted, each cam ring can be driven separately.

[0025] The driving device can be operated by an appropriate pressure medium, so that corresponding pneumatic or hydraulic lines are additionally arranged for the supply of the driving device. In a simple embodiment, which requires relatively little design effort to supply the driving device while simultaneously allowing controlling the driving device in a simple way, the driving device presents at least one electric motor, whose driven shaft has a driving connection to the pinion or pinions. Additional driven devices can be provided, for example, in order to drive a pinion or more than one pinion via the driven shaft, in order to drive different pinions in different directions, or also in order to drive all pinions in the same rotational direction.

[0026] For reasons of redundancy or also in order to be able to use relatively small, and therefore not as powerful, electric motors, several electric motors can be allocated to each driven shaft. In a simple arrangement, the driven shaft extends across all electric motors, so that, for example, these can turn the driven shaft separately or also synchronously controlled.

[0027] For reasons of redundancy and also in order to ~~realise~~realize appropriate power even when relatively low-powered electric motors are used, it is also possible for at least two driven shafts with one or more electric motors to be arranged at a distance from one another in the

circumferential direction of the cam rings. With two driven shafts, these are advantageously arranged diametrically opposite one another with respect to the longitudinal bore hole of the one part. With three or more driven shafts, these are correspondingly arranged at equal distances apart in the circumferential direction. At the same time, the driven shafts can be mechanically coupled in their rotational movements.

[0028] It is still noted that, when, for example, one or two driven shafts are used, it is also possible for additional idle pinions to be arranged in the circumferential direction to the cam rings, which, while meshed with the gearing of the cam rings, are not themselves driven, however, but which instead essentially only serve the lateral support of the cam rings.

[0029] In order to drive the cam rings separately in a simple way, pinions with driving connections to different driven shafts can mesh with different cam rings. In this way, for example, it is possible to do without corresponding coupling devices if the cam rings are to be driven at different times, at different speeds, with different directions of rotation and the like.

[0030] It is true that usually the rotational speeds of the electric motors are adjustable. However, in order to ~~realise~~realize an appropriate gear reduction for the rotation of the cam rings in a simple way, a step-down gear unit, in particular a so-called harmonic drive, can be arranged between the driven shaft and the pinion.

[0031] In order to ensure the connection of the parts that can be inserted into one another even when the parts are not accurately aligned and, simultaneously, to ~~realise~~realize a certain interlocking of the connection even with contact elements that are arranged in only one level, it is possible for the contact element to present a concavely curved inner surface and/or to be formed essentially in a wedge-shape in the direction radially towards the inside, relative to the supporting ring. Because of the concave curvature, an essentially plane contact with the part to be attached occurs, and because of the wedge shape, simplified insertion in the corresponding retaining indentation occurs, as well as a certain interlocking of the connection, for example, in order to ensure a connection of the two parts relative to one another that is relatively simple and without play.

[0032] In order to be able to arrange the driving device, in particular, on the one part simply, the one part can present at least one retainer bore hole for the driving device in its wall, on its insertion end for the other part. In this retainer bore hole, which can also be formed in a ring shape, at least the driven shaft with the electric motor(s) and, where appropriate, also the step-down gear unit are inserted. Naturally, it is also possible for the pinions, the cam rings and the supporting rings to be accommodated and supported in this retainer bore hole.

[0033] However, in order to simplify the accessibility of the parts outside of the actual drive mechanism, the wall on the insertion end can present a ring clearance zone on the inside, in which a sleeve is detachably attached, which is formed at least for the rotatable support of the cam rings and the support of the supporting rings.

[0034] In order to simplify the allocation of the parts that are to be inserted into one another, the retaining indentation in the other part can be formed as a surrounding snap ring groove. In this way, it is ensured that a secure meshing of the contact elements in the retaining indentation is always possible, even with differing orientations of the parts to one another.

[0035] The insertion of the contact elements into the retaining indentation can furthermore be simplified by means of expanding the retaining indentation in the other part, in the direction of the contact element.

[0036] Different shapes are conceivable for the ~~realisation~~realization of the contact elements. The contact elements can, for example, be finger-shaped or the like. Likewise, it is possible for the contact elements to be formed so that they are essentially claw- or latch-shaped.

[0037] In order to support the cam rings, particularly in the area of the pinions, meaning the transmission of the driving power, two pivot bearings can be allocated for each bearing shaft with a driving connection to the driven shaft for the pinion(s), one on each side of it, in the circumferential direction of the cam rings.

[0038] Should there be a requirement to monitor parts of the drive mechanism with regard to their position, the position of the driven shaft and/or bearing shaft and/or pinion and/or cam ring and/or contact element can be registered by means of a position sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] An advantageous embodiment of the invention is explained in more detail using the figures included with the drawing.

Shown are:

[0040] Figure 1 shows a cut along line I-I from Figure 2 of an embodiment of a connecting mechanism according to the invention and

[0041] Figure 2 shows a cut along the line II-II from Figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] Figure 1 shows an embodiment of a connecting mechanism 1 according to the invention with a cut along the line I-I from Figure 2. The connecting mechanism 1 is held in a tubular part 2, which, for example, can bring about a connection from an upper end of a stack of BOPs (blowout preventers) to a so-called riser.

[0043] The tubular part 2 presents a longitudinal bore hole 20, in which a tubular second part 3 can be inserted from an insertion end 45. The other part 3 is inserted into part 2 so far that it is arranged with its free end 21 roughly in the ~~centre~~-center of part 2 according to Figure 1.

[0044] In a wall 19 of part 2, in the embodiment shown, four retainer bore holes 46 are formed in which driving devices 13 are inserted. The retainer bore holes 46 can also be formed from an annulus.

[0045] Above the retainer bore hole 46, part 2 presents a ring clearance zone 47, which is open towards the longitudinal bore hole 20. An insertion sleeve 48 is detachably placed in this. In particular, this serves for the support of bearing shafts 50, which have a driving connection with the driving device 13.

[0046] The insertion sleeve 48 likewise presents an internal bore hole that continues the longitudinal bore hole 20, which is expanded towards the outside on the upper end, meaning the insertion end 45 of part 2.

[0047] The driving devices 13 in the embodiment shown are formed by four electric motors 39 arranged on a driven shaft 40, 41. The corresponding driven shaft 40, 41 is connected to the corresponding bearing shafts 50 over a step-down gear unit 42, which is formed as a so-called harmonic drive 43. Such a harmonic drive 43 is known in itself, and includes at least one stationary ring with internal gearing, a flexible sleeve with external gearing and with a driving connection to the driven shaft 40, 41 in the embodiment shown, as well as a shaft generator with a driving connection to the bearing shafts 50.

[0048] One or more pinions 38 are arranged on the corresponding bearing shaft 50 (see Figure 2 as well). These are meshed with an external gearing 37 on the outside circumference 36 of cam rings 22 as the cam-operated component 6. A total of three cam rings 22 are arranged, whereby each cam ring presents corresponding sliding cams 23 or a link guide 28 on the inner surface of its ring 24, see Figure 2 as well, by means of which the contact elements 7, 8, 9 can be shifted between a withdrawal position 10 and a contact position 11. With regard to the withdrawal and contact positions of the contact elements, it must be noted that they are suggested in Figure 2 for a contact element 9 and the accompanying cam ring. Otherwise, all contact elements 7, 8, 9 are arranged in the contact position 11 in Figure 2.

[0049] In Figure 1, it is particularly shown for the contact elements 7 arranged in a level 14, that these engage in a retaining indentation 12, formed as a snap ring groove 49, on part 3. This applies in the same way for the contact elements 8 and 9 arranged in the levels 15 and 16. The different levels 14, 15 and 16 with contact elements 7, 8, 9 are essentially arranged so that they

are parallel and vertical to the insertion direction 17, in which direction part 3 can be inserted into part 2. The contact elements 7, 8, 9 are formed so that they are essentially claw- or latch-shaped and, on their inner surface that radially faces inwards to the longitudinal bore hole 20, present a concave curvature, which essentially corresponds to a corresponding curvature of the snap ring groove 49. Furthermore, the contact elements 7, 8, 9 run wedge-shaped in the direction radially inward, whereby this wedge shape is essentially complementary to the shape of the snap ring groove 49 (see Figure 1 in level 14).

[0050] The contact elements 7, 8, 9 adjustably run on bearings in levels 14, 15 and 16 between their contact position 11 and their withdrawal position 10, in different supporting rings 25, 26, 27. At the same time, the contact elements are force- and, in particular, spring-~~pressurised~~pressurized in the direction of the withdrawal position 10. Because of this ~~pressurisation~~pressurization, the contact elements 7, 8, 9 make contact on the usually rotatable locating elements 29 with an inner surface of the ring 24 (see Figure 2) of the cam rings 22, whereby the corresponding sliding cams 23 or the link guide 28 is formed on this inner surface of the ring 24.

[0051] Figure 2 corresponds to a cut along the line II-II through Figure 1. In Figure 2, it is particularly evident that the contact elements 7, 8, 9 of the different levels 14, 15, 16 or the supporting rings 25, 26, 27 stand out at different distances radially toward the inside in the direction of the interior 18 of the longitudinal bore holes 20 of part 2. This is possible because of the different link guides 28 or sliding cams 23 of the cam rings 22.

[0052] Each cam ring 22 presents gearing 37 on its outside circumference 36, which is meshed with the pinions 38. Pivot bearings 31, formed as ball bearings, are arranged on both sides of each pinion 38, which pivot bearings are arranged between the different cam rings 22 to maintain an appropriate distance and to ensure concentric running of the cam rings. Depending on the direction of rotation of the driving devices 13, the cam rings 22 rotate in the circumferential direction 30 or direction of rotation 32. The driving devices are evenly spaced in the circumferential direction 30 and, where appropriate, arranged so that they are offset to one another.

[0053] In Figure 1, a mechanical coupling device 52 is shown for a further embodiment of the connecting mechanism according to the invention, which device mechanically couples the rotational movements of the driven shafts 40, 41. In this way, a corresponding synchronous rotation of the driven shafts 40, 41, as well as any additional driven shafts that may be present, is ensured. In the embodiment shown, the mechanical coupling device 52 is formed by a toothed

wheel or pinion 54 arranged on the corresponding driven shafts and a chain 53 that is meshed with it. The mechanical connection of the different pinions 54 on the driven shafts is made over the chain 54.

[0054] Likewise, the mechanical coupling device 52 can be formed from pinions with a toothed belt or as a gear set.

[0055] A corresponding mechanical coupling device 52 on the other driven shaft 14 is not shown, in the interest of simplification.

[0056] In Figure 2, the contact elements 7 of level 14 or of the supporting ring 25 are visible, while the contact elements 8, 9 of levels 15, 16 or supporting rings 26, 27 are arranged lying below them. It is furthermore evident that the contact elements 7 of level 14 project the farthest in their contact position 11 radially towards the inside in the direction of the longitudinal bore hole 20, whereby this projection decreases up until the contact elements 9 of level 16. Furthermore, it is possible for the contact elements 7, 8, 9 also to project at different distances radially towards the inside in the direction of the longitudinal bore hole 20 in their respective levels 14, 15, 16.

[0057] The adjustment of the cam-operated component 6 or the individual cam rings 22 between the passive and active positions 4, 5 is determined by a guiding cut 33 that runs in the direction of rotation 22. If a pin or similar object that engages in the guide slot 33 is in contact with the end 34 of the guide slot 33, the corresponding cam ring 22 is in its active position 5. If instead, this pin is in contact with the other end 35, the corresponding cam ring is in its passive position 4.

[0058] In the following, the functional mode of the connecting mechanism according to the invention is briefly explained using the figures.

[0059] After the insertion of a tubular part 1 into the similarly essentially tubular part 2, a quick-disconnect connection is made between these parts by operating the driving devices 13 in such a way that the cam rings 22 are twisted into their active position 5 via the corresponding bearing shafts 50 and pinions 38. In this active position 5, the contact elements 7, 8, 9 in the levels 14, 15, 16 are radially shifted towards the inside, from their withdrawal position 10 into their contact position 11, by the corresponding link guides 28 or sliding cams 23 on the inner ring surface 24 of the cam rings 22. In these contact positions 11, the contact elements 7, 8, 9 engage in the corresponding retaining indentations 12, formed as snap ring grooves 49, of part 3. By using the electric motors for the driving device 13, the connecting mechanism is entirely electrified and can be easily operated by remote control. At the same time, the adjustment of the driving device can be measured by means of the corresponding position sensors 51 (see Figure 1), whereby,

however, it is also possible to allocate such position sensors 51 to the driven shaft 40, 41, the bearing shafts 50, the pinions 38, the cam rings 22 or, where appropriate, also to the contact elements 7, 8, 9.

[0060] If the connection of parts 2 and 3 should be disconnected again quickly, the driving device is simply operated in the reverse direction, so that, similarly, the cam rings 22 are turned back to their passive position 4 and the contact elements 7, 8, 9 move into their withdrawal positions 10. In this way, they no longer mesh with the corresponding retaining indentations 12 of part 3, and part 3 can easily be pulled out of part 2.

[0061] It is still noted that the connecting mechanism according to the invention can be used not only for the connection of two tubular parts 2, 3, but also for holding in place or connecting other parts, whereby (see the explanations at the beginning) complete insertion of a part in a housing, such as a valve, a choke or the like, can similarly take place, and this inserted part is held in place and position by the connecting mechanism according to the invention.

Connecting Mechanism

CLAIMS

1. (currently amended) Connecting mechanism ~~(1)~~ for two parts ~~(2, 3)~~, which are at least partially insertable into one another, with a cam-operated component ~~(6)~~, which runs on bearings on the one part ~~(2)~~ and is adjustable between a passive and active position ~~(4, 5)~~ for shifting a number of contact elements ~~(7, 8, 9)~~ between a withdrawal and a contact position ~~(10, 11)~~, whereby the contact elements ~~(7, 8, 9)~~, when in the contact position ~~(11)~~, mesh in a retaining indentation ~~(12)~~ on the other part ~~(3)~~, and with a driving device ~~(13)~~ for the adjustment of the cam-operated component ~~(6)~~ between the active and passive position ~~(4, 5)~~, ~~characterised~~ characterized in that the contact elements ~~(7, 8, 9)~~ are allocated in two or more levels ~~(14, 15, 16)~~ essentially parallel to the insertion direction ~~(17)~~ of the two parts ~~(2, 3)~~ and the cam-operated component ~~(6)~~ for shifting the contact elements ~~(7, 8, 9)~~ between the withdrawal and contact positions ~~(10, 11)~~ is allocated to each level ~~(14, 15, 16)~~.
2. (currently amended) Connecting mechanism according to claim 1, ~~characterised~~ characterized in that the parts ~~(2, 3)~~ that are insertable into one another are tubular.
3. (currently amended) Connecting mechanism according to claim 1 ~~or 2~~, ~~characterised~~ characterized in that this mechanism ~~(1)~~ is arranged in the interior ~~(18)~~ of the one part ~~(2)~~ and, in particular, in its wall ~~(19)~~, whereby the other part ~~(3)~~ can be inserted, with at least one end ~~(21)~~, into a longitudinal bore hole ~~(20)~~ of the one part ~~(2)~~.
4. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims~~, ~~characterised~~ characterized in that the cam-operated component ~~(6)~~ presents at least one cam ring ~~(22)~~, rotatably running on bearings, with sliding cams ~~(23)~~ on an inner surface of the ring ~~(24)~~.
5. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims~~, ~~characterised~~ characterized in that a cam ring ~~(22)~~ is allocated to each level ~~(14, 15, 16)~~ of contact elements ~~(7, 8, 9)~~.
6. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims~~, ~~characterised~~ characterized in that the contact elements ~~(7, 8, 9)~~ run in bearings in a

supporting ring ~~(25, 26, 27)~~ in such a way that they are adjustable between the withdrawal and contact positions ~~(10, 11)~~.

7. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that a supporting ring ~~(25, 26, 27)~~ is allocated to each level ~~(14, 15, 16)~~.

8. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the sliding cams ~~(23)~~ are formed on the inner surface of the ring ~~(24)~~ as a link guide ~~(28)~~.

9. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact element ~~(7, 8, 9)~~, with a locating element ~~(29)~~ that runs on bearings so that it is especially rotatable, is in contact with the inner surface of the ring ~~(24)~~.

10. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact element ~~(7, 8, 9)~~ is force- and, in particular, spring-~~pressurised~~ pressurized in the direction of the withdrawal position ~~(10)~~.

11. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact elements ~~(7, 8, 9)~~ of different levels ~~(14, 15, 16)~~ present contact positions ~~(11)~~ that are shifted in different amounts, at least radially towards the interior.

12. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact elements ~~(7, 8, 9)~~ of one level ~~(14, 15, 16)~~ present contact positions ~~(11)~~ that are shifted at least in different amounts radially towards the interior.

13. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact elements ~~(7, 8, 9)~~ of different levels ~~(14, 15, 16)~~ are arranged offset to one another in the circumferential direction ~~(30)~~.

14. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that pivot bearings ~~(31)~~, in particular ball bearings, are arranged between adjacent cam rings ~~(22)~~.
15. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the cam ring ~~(22)~~ presents a guide slot ~~(33)~~ that runs in the direction of rotation ~~(32)~~, through the ends ~~(34, 35)~~ of which essentially the passive and active positions ~~(4, 5)~~ of the cam ring ~~(22)~~ are determined.
16. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the cam ring ~~(22)~~ presents a gearing ~~(37)~~ at least along one part of its outside circumference ~~(36)~~, with which a pinion ~~(38)~~ that can be rotated by the driving device ~~(13)~~ meshes.
17. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that each cam ring ~~(22)~~ is driven separately.
18. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the driving device ~~(13)~~ presents at least one electric motor ~~(39)~~, whose driven shaft ~~(40, 41)~~ has a driving connection with the pinion ~~(38)~~.
19. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that several electric motors ~~(39)~~ are allocated to the driven shaft ~~(40, 41)~~.
20. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that two or more driven shafts ~~(40, 41)~~ with one or more electric motors ~~(39)~~ are arranged in the circumferential direction ~~(30)~~ of the cam ring ~~(22)~~ at a distance from one another.

21. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that pinions (38) with a driving connection to different driven shafts (40, 41) are meshed with different cam rings (22).
22. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that a step-down gear unit (42), in particular, a so-called harmonic drive (43), is arranged between the driven shaft (40, 41) and pinion (38).
23. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the contact element (7, 8, 9) presents a concave curved inner surface (44) and/or is formed essentially wedge-shaped running in the direction radially inwards relative to the supporting ring (25, 26, 27).
24. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the one part (2) presents at least one retainer bore hole (46) for the driving device (13) in its wall (19), in its insertion end (45) for the other part (3).
25. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the wall (19) on the insertion end (45) presents an interior ring clearance zone (47), in which an insertion sleeve (48) is attached in a way that it can be detached, which is formed at least for the rotatable support of the cam rings (22) and for the support of the supporting rings (25, 26, 27).
26. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the retaining indentation (12) in the other part (3) is formed as a revolving snap ring groove (49).
27. (currently amended) Connecting mechanism according to claim 1 ~~one of the previous claims, characterised~~ characterized in that the retaining indentation (12) in the other part (3) is expanded in the direction of the contact element (7, 8, 9).

28. (currently amended) Connecting mechanism according to claim 1~~one of the previous claims, characterised~~characterized in that the contact element ~~(7, 8, 9)~~ is essentially formed so that it is claw- or latch-shaped.

29. (currently amended) Connecting mechanism according to claim 1~~one of the previous claims, characterised~~characterized in that two pivot bearings ~~(31)~~ are arranged on each side of a bearing shaft ~~(50)~~ that has a driving connection with the driven shaft ~~(40, 41)~~ for the pinion(s) ~~(38)~~ in the circumferential direction ~~(30)~~ of the cam ring ~~(22)~~.

30. (currently amended) Connecting mechanism according to claim 1~~one of the previous claims, characterised~~characterized in that the position of the driven shaft ~~(40, 41)~~ and/or bearing shaft ~~(50)~~ and/or pinion ~~(38)~~ and/or cam ring ~~(22)~~ and/or contact element ~~(7, 8, 9)~~ can be registered by means of a position sensor ~~(51)~~.

31. (currently amended) Connecting mechanism according to claim 1~~one of the previous claims, characterised~~characterized in that the driven shafts ~~(40, 41)~~ are mechanically ~~synchronised~~synchronized in their rotational movements.

ABSTRACT

A connecting mechanism ~~(1)~~ for two parts ~~(2, 3)~~, which are at least partially insertable into one another, presents a cam-operated component ~~(6)~~, which runs on bearings and which is adjustable between a passive and an active position ~~(4, 5)~~, on the one part ~~(2)~~, for shifting a number of contact elements ~~(7, 8, 9)~~ between a withdrawal and a contact position ~~(10, 11)~~, whereby the contact elements ~~(7, 8, 9)~~, when in the contact position ~~(11)~~, mesh in a retaining indentation ~~(12)~~ on the other part ~~(3)~~, and a driving device ~~(13)~~ for the adjustment of the cam-operated component ~~(6)~~ between the active and passive positions ~~(4, 5)~~. In order to ensure a secure and stable connection of these parts, using simple design means without additional pre-stressing or restraining devices, even when the parts are only partially inserted into one another, the contact elements ~~(7, 8, 9)~~ are arranged in two or more levels ~~(14, 15, 16)~~ essentially parallel to the insertion direction ~~(17)~~ of the two parts ~~(2, 3)~~ and the cam-operated component ~~(6)~~ for shifting the contact elements ~~(7, 8, 9)~~ between the withdrawal and contact positions ~~(10, 11)~~ is allocated to each level ~~(14, 15, 16)~~.